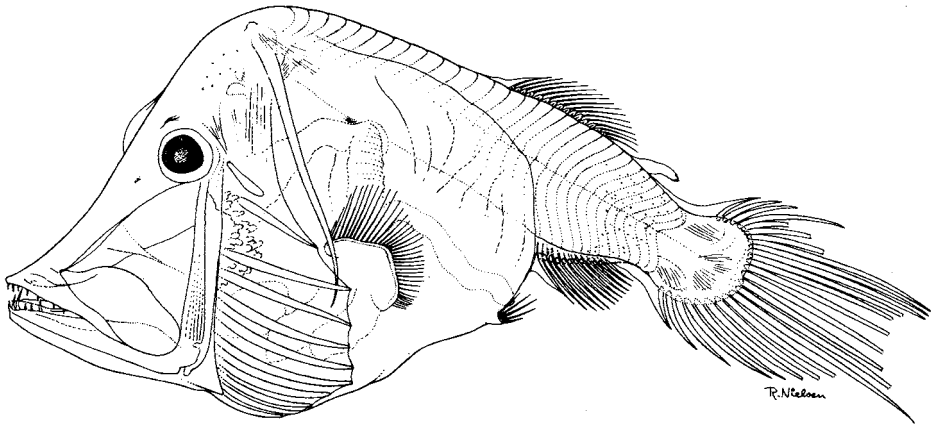
NOAA Technical Memorandum NMFS-SEFSC-484

PRELIMINARY GUIDE TO THE IDENTIFICATION OF THE EARLY LIFE HISTORY STAGES OF GIGANTURID FISHES OF THE WESTERN CENTRAL NORTH ATLANTIC

BY

THOMAS L. JACKSON



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National Marine Fisheries Service
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FAMILY GIGANTURIDAE: Telescope fishes

by Thomas L. Jackson

The Giganturidae (telescope fishes) is a small family, comprised of two species; *Gigantura chuni*, and *G. indica* (Brauer, 1901). Specimens of giganturids have been collected in the Atlantic, Indian, and Pacific Oceans. They are distinct in that they exhibit an unusually long larval stage, as well as a late and unique transformation. They have developmental characteristics that are considered to be neotenic. The larvae and early juveniles were once thought to be members of a separate genus; *Rosaura rotunda* (Tucker 1954). Subsequently, the late Elbert H. Ahlstrom and F. H. Berry made the connection between the larval and adult giganturids (and *Rosaura*), due to their sharing 1) high pectoral fin counts, and 2) an unusual 10+6(7) principle caudal ray count. Giganturid larvae live a lengthy epipelagic existence. They then complete a delayed metamorphosis to adapt to life at a deeper habitat as deep meso- or upper-bathypelagic adults. Both *Gigantura chuni*, and *G. indica* are synchronous hermaphrodites. Their life history, unusual neotenic morphogenesis, and species descriptions are expertly discussed and illustrated in Johnson and Bertelsen (1991).

Gigantura chuni

Gigantura chuni (Brauer 1901)
original name
Gigantura vorax (Reagan 1925)
junior synonym

Gigantura indica

Gigantura indica (Brauer 1901)
original name
Rosaura indica (Brauer 1901)
Bathyleptus gracilis (Reagan 1925)
junior synonym
Gigantura gracilis (Reagan 1925)
junior synonym
Bathyleptus lisae (Walters 1961)
junior synonym
Rosaura lisae (Walters 1961)
junior synonym

Specimens previously identified as *Bathyleptus* (Walters, 1961) and *Rosaura* (Tucker, 1954) were both later identified as junior synonyms of *Gigantura* by Johnson and Bertelsen, 1991. *G. gracilis*, and G. *vorax* (Reagan 1925) were later re-identified as members of *G. indica* and *G. chuni* respectively (Johnson and Bertelsen, 1991).

Giganturids generally range from 37-55mm after transformation. The maximum SL length seen was 177 mm for *G. chuni*, and 223 mm for *G. indica*. As adults these fishes are heavily pigmented and "silverish" in color. They are scaleless, and have loose skin with a thick under layer of mesenchymal jelly (Johnson and Bertelsen, 1991). Adults are slender and long, soft bodied, and fragile. Unlike the larvae, they possess large, forward oriented, oval, tubular eyes. The development of their gape changes where in larvae it only extends below the eye, however after transformation the gape extends far posterior to the tubular eye. In adults the hyoid is extended posteriorly to the middle of the broad based pectoral fin, thereby significantly increasing their gape. Their gape allows them to be more opportunistic with their possible prey's ranges in sizes. Their teeth are sharp and depressible, and their stomach is expandable. The premaxillary dentition is biserate (or in older specimens triserate) with the radial teeth being prominent fangs. Each of their two nostrils have singular olfactory papillae that are elongate, club shaped and, in older specimens proximally pigmented in *G. chuni*, while shorter, broader and unpigmented in *G. indica*. The lateral cephalic-laterosensory system is best developed paralleling the margin of the upper jaw having a close association with the infraorbitals. Due to their fragile nature, and lack of specimens with intact skin there is no evidence of an organized lateral line system. Other pores were observed in the head but were not noted as to location (Johnson and Bertelsen, 1991). Giganturids are one of the only living groups with a relatively large, pectoral fin located high on the body, with an orientation horizontal to the body's axis, above the gill opening. Fin rays are not segmented at any point of either species development, but some are branched, particularly in the caudal fin. In adults (Tables Giganturidae 1-3) there are no pelvic fins, or adipose fin. The dorsal fin has 16-18 dorsal rays. All other fin ray counts are unchanged from larva to adult. The pectoral fin counts differ between species; *G. chuni* having 30-33 rays, and *G. indica* having 36-42 rays.

The same is true for anal fin counts where *G. chuni* have 8-10 anal rays, while *G. indica* has 11-14 anal rays. The posterior most anal fin ray is mostly documented as single. However, in some specimens, the last 2 rays are located close together having the appearance that the terminal ray went through a process of division. This has yet to be substantiated. The caudal peduncle is oval in cross section in *G. chuni*, and is almost round in cross section in G. indica. The hypocercal caudal fin is forked and possesses extended lengthy, central, lower rays as long or longer than the SL. As adults their cranial osteology lacks orbitosphaenoids; and in the suspensory and branchial bones they lack post temporals, supratemporals, parietals, symplectics, gill rakers, branchiostegals, and cleithrums. Where the 10 plate-like branchiostegals were prominently seen in the larvae, there is only the thin sheet of skin from mandible to mandible in adults that forms the floor of the oral cavity. One possible explanation for the loss of the branchistegals during transformation is to counteract the decrease in the relative size of the head of adults. The loss of the branchiostegals could allow larger sized prey into the mouth. In larvae the head is significantly larger in proportion to the body, thus the branchiostegals act to protect the branchoistegal membranes while aid in preventing prey from exiting the rear of the mouth through the gill openings. As larvae and adults these species have a distinct anal papilla that is located adjacent to the location of the bases of the pelvic fins (pelvics only evident in larvae). Giganturids lack a swim bladder.

Giganturid larvae are rarely encountered in this portion of the Atlantic but are distinctly identifiable. The larvae of both species historically have been captured from 17 to 170 m depth most between 30 and 170 m depth. However, *G. chuni* showed a distinct maximum in specimens captured at 100 m (Johnson and Bertelsen 1991). They are superficially similar to larvae of some scopelarchid genera *Rosenblattichthys* and *Scopelarchoides* (Johnson 1974, 1982), as well as some ceratioids (Bertelsen, 1951). However, giganturid larvae are unique in many of their characteristics. The larval stage lasts an extended portion of their lifecycle and shows distinct neotenic characteristics during and post transformation. As larvae they possess; pelvic fins, an adipose fin, massive cliethra, normal round eyes, and 10 large plate-like branchiostegal rays.

The larvae of both species are structurally similar and are described as having a globose, highly inflated, translucent body, with a massive head, and a small pointed snout (see Figs 1,2). Unlike the adults they do not possess forward oriented tubular eyes, but have small round laterally oriented eyes. Larval giganturids have two to three rows of numerous, unbarbed, depressible teeth which are lost and replaced in adults during transformation. In the adults dentition on the premaxilla is biserate (or in larger specimens triserate) and obvious medial fangs are present. Even in the smallest known larvae (4 mm SL) raptorial teeth are present. The larvae have toothed premaxillaries and long rostral processes. The maxillary is excluded from the gape in adults while their maxillary is not excluded from the gape in larvae. The gill openings are wide, and bordered by the branchiostegal membranes that are continuous below. The 10 branchiostegals are only connected anteriorly and are completely free posteriorly and vertrally. There is no connection to the isthmus in either the larvae or adults. The suspensorioum is nearly vertical in the larvae. The abdominal wall is essentially transparent and an expansive balloon like gut is visible. The gut is bordered anteriorly by the pectoral girdle. In both species of larvae, all fins are present, including an adipose fin. They also possess pedunculate, rayed pectoral fins that are located lower on the body adjacent to, behind, and below the dorsal point of the gill opening. Giganturid larvae are also unique in having a small, single blotch of peritoneal pigment lying just above, and posterior to, the dorsal transverse limb of the intestine – this characteristic somewhat shared with some members of the scopelarchidae (Johnson 1974). Other than the characteristic peritoneal patch, both species exhibit pigment in the eyes, over the optic lobes and cerebellum, and on the sides of the body posterior to the dorsal fin base. A few specimens of *G. chuni* have small punctate melanophores located over the lateral abdominal body wall. They possess little other pigment until transformation.

Five non overlapping characters separate the larval forms of the two species (also see Giganturidae Table 1): 1) comparing the depth of the caudal peduncle as a % of SL (average in parentheses) where for *G. chuni* =12-16(14)%, and for *G. indica* 7.4-11(9.5)%; 2)

interorbital width as a % of SL which ranges from 5.9-13% (9.4) in *G. chuni*, and 12-20(15)% in *G. indica;* 3) the cross sectional shape of the caudal peduncle where in *G. chuni* the caudal peduncle is deep and oval, and in *G. indica* is narrow and round (however, this characteristic is more pronounced in adults); 4) comparison of anal fin ray counts where in *G. chuni* anal fin rays =8-10, and in *G. indica* anal fin rays =11-14; and 5) comparison of pectoral fin ray counts were in *G. chuni* pectoral fin rays =30-33 and in *G. indica* pectoral fin rays =36-42.

In *G. chuni* the depth of the caudal peduncle to the SL is an unchanging relationship after transformation, with no significant change from larvae to adult. *G. indica* larvae begin to show a marked reduction in the depth of the caudal peduncle before the end of the larval stage, continues in juveniles up to 80mm SL, and remaining constant during the rest of the life cycle. One other noticeable interspecies difference is that in *G. chuni*, above and behind the visceral cavity, the body is a strongly laterally compressed which is maximized towards the caudal peduncle hence they are oval in cross section where *G. indica* are round in cross section.

The transformation stages (**see Figs 3,4)** from larvae to adults occurs at a considerably large size for teleosts (25-34mm) (Johnson 1984: Johnson & Bertelsen, 1991). The end of the larval stage is most obviously indicated by the development of extensive pigmentation of the body, concurrently the larval dentition is lost and replaced with adult dentition. The juvenile stage starts with the completion of the development of the tubular eyes. In the process they also resorb their adipose fin and lose their pelvic fins. Giganturid transformation is considered to be extreme for all fishes.

Table Giganturidae 1. Comparison of characteristics for the identification of larval *Gigantura chuni* and *G. indica*

Characteristic	*G. chuni*	*G. indica*
pectoral fin rays	30-33	36-42
anal fin rays	8-10	11-14
depth of caudal peduncle as % of SL	12-16% (14)	7.4-11% (9.5)
interorbital width as % of SL	5.9-13% (9.4)	12-20% (15)
caudal peduncle X-section	oval	round

Table Giganturidae 2. Comparison of larvae and adult characteristics of *Gigantura* sp. Table adapted from Johnson and Bertelsen, (1991)

	Characteristic	Larvae	Adults
1.	body shape	short, deep and rotund	elongate, shallow and slender
2.	snout shape	pointed	round
3.	gape	does not extend posteriorly of the eye	extends very posterior to the eye
4.	pigmentation	transparent, with few scattered black with bright	densely pigmented, larval melanophores silvery layer
5.	eyes	round, laterally directed, mobile,	tubular, directed rostrad, immobile placed high above jaws placed close to upper jaws
6.	teeth	non-depressible posterior hinged	
7.	(?) teeth)	2-4	absent
8.	maxillary	short, posteriorly not reaching below anterior part of the eye	long, posteriorly reaching far behind max in gape the eye, max excluded from gape
9.	branchiostegal rays	10, large	
	flattened	absent	
10.	pelvic fins	pedunculate	
	with 5 rays	absent	
11.	adipose fin	present	
		absent	
12.	orien. of pectoral fins	vertical;	
	behind gill slit	nearly horizontal; above gill slit	
13.	?rent caudal finrays	(3)-4-(5)	(0)-1(2-3)
14.	cleithra	massive	
	cleithra	absent	

Table Giganturidae 3. Comparison of characteristics used in the separation of adult *Gigantura chuni* from *G. indica*

Characteristic	*G. chuni* / *G. indica*
Head length as % of SL	25% / 15%
Depth of the body in *G. indica*	200% seen / -
Depth of caudal peduncle in *G. indica**1	300% seen / -
Olfactory papilla clubshaped and proximally pigmented*2	elongate, / shorter, broader, unpigmented

*1 this characteristic also separates the two larval species

*2 proximal pigmentation visible in older (larger) speciemens of *G. chuni*

FAMILY GIGANTURIDAE

***Gigantura chuni* Brauer 1901**

MERISTICS

Vertebrae:	
Total	29-31
Number of Fin Spines and Rays:	
Dorsal	16-18
Anal	11-14
Pectoral	30-33
Pelvic	5
Caudal	
Principal	10+6(7)

LIFE HISTORY

Range: Distributed in Atlantic, Indian, & Pacific Oceans with a majority found between 20° N & 10° S.

Habitat: mesopelagic/upper bathypelagic (adults); epipelagic (larvae).

ELH Pattern: epipelagic as larvae 30 – 170 m (and <300 m) depth with a catch maximum at 100 m; transforming stages then sink or drift to the mesopelagic or upper bathypelagic; late juviniles and adults most common from 500 m – 1500m

Spawning: Synchronous hermaphrodites.

LITERATURE

Tucker 1954, Johnson & Bertelsen 1991

EARLY LIFE HISTORY DESCRIPTION

EGGS:

Diameter: (0.8-1.0mm) only from mature ovaries

LARVAE:

Length at Transformation: starts at 25-34mm SL/ end 36-37mm

Length of gut: 2/3–3/4 length of abdominal cavity

Pigmentation: unpaired blotch of peritoneal pigment lying just above, & posterior to, the dorsal transverse limb of the intestine; punctate melanophores located over the lateral abdominal body wall in some speciemens; spots evident in the eyes, over the optic lobes, cerebellum, & on the sides of the body posterior to the dorsal fin base

DIAGNOSTIC CHARACTERS:

P = 30-33; A = 8-10; depth of caudal peduncle as % of SL =12-16% (14); interorbital width as % of SL = 5.9-13% (9.4); caudal peduncle oval in cross section

ILLUSTRATIONS

All from Johnson & Bertelsen (1991). A: 6.1mm, Dana St. 3919 IV, B: 13.6mm, Dana St. 3767 II, C: 16.5mm Dana St. 3815 VI.

FAMILY GIGANTURIDAE — *Gigantura indica* Brauer, 1901

MERISTICS

Vertebrae:	
Total	29-31
Number of Fin Spines and Rays:	
Dorsal	16-18
Anal	11-14
Pectoral	36-43
Pelvic	5
Caudal	
Principal	10+6(7)

LIFE HISTORY

Range: Distributed in the Atlantic, Indian, & Pacific Oceans, widely in the central & equatorial waters with a majority found between 30° N and 30° S.

Habitat: mesopelagic/upper bathypelagic (adults), epipelagic (larvae).

ELH Pattern: epipelagig as larvae 30 – 170m (and <300 m) depth; then transform and sink or drift to the mesopelagic or upper bathypelagic as adults; late juviniles and adults most common from 500 m – 2100 m

Spawning: Synchronous hermaphrodites

LITERATURE

Tucker 1954**,** Johnson & Bertelsen 1991.

EARLY LIFE HISTORY DESCRIPTION

EGGS:

Diameter: (0.8-1.0mm) only from mature ovaries.

LARVAE:

Length at Transformation: starts at 25-34 mm SL/ end 45-55 mm SL.

Length of gut: 1/3 the length of the abdominal cavity

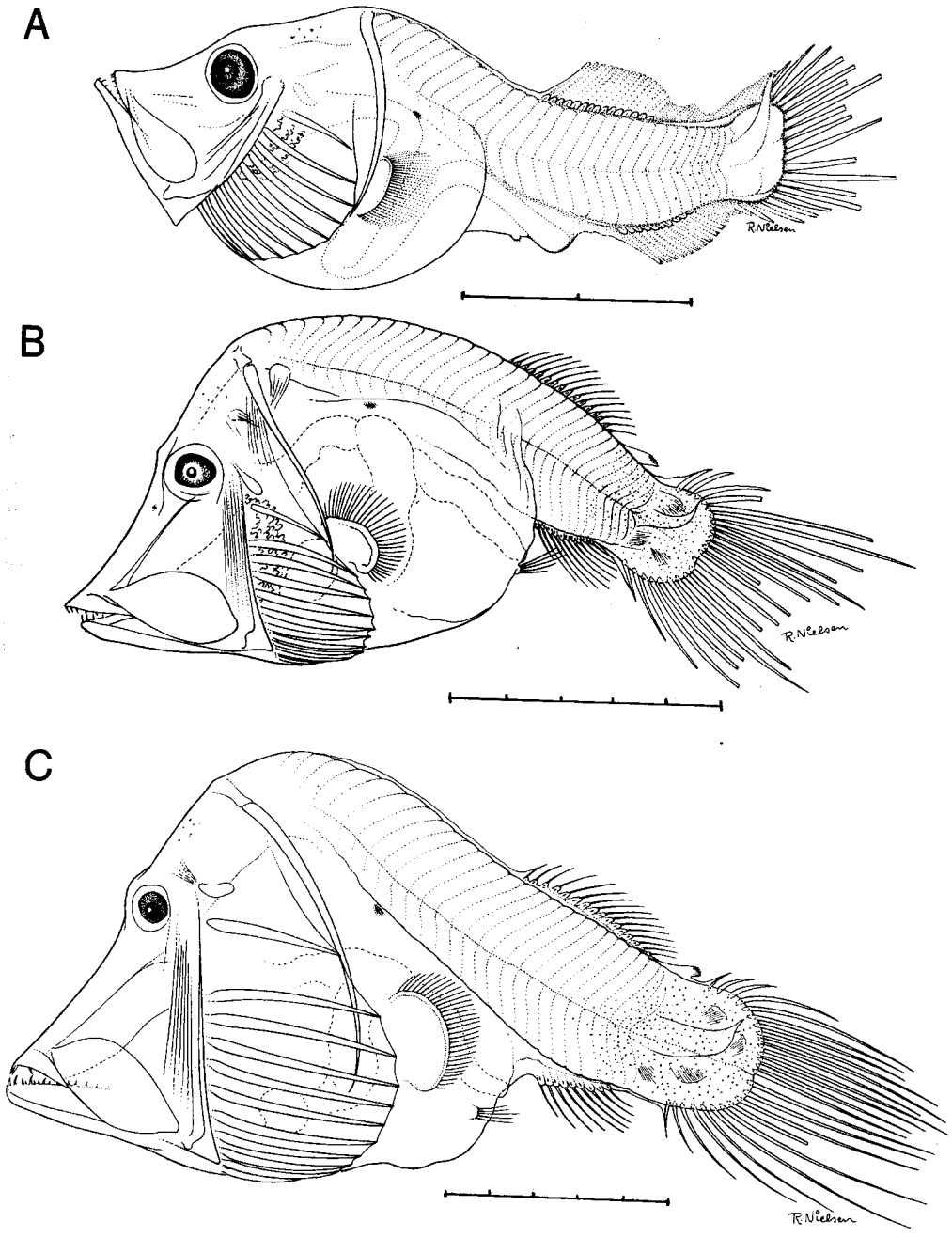
Pigmentation: unpaired blotch of peritoneal pigment lying just above, & posterior to, the dorsal transverse limb of the intestine; spots evident in the eyes, over the optic lobes, cerebellum, & on the sides of the body posterior to the dorsal fin base

DIAGNOSTIC CHARACTERS:

P = 36-42; A = 11-14; depth of caudal peduncle as % of SL = 7.4-11(9.5)%; interorbital width as % of SL = 12-20(15)%; Caudal peduncle round in cross section

ILLUSTRATIONS

A: 3.6mm, HUP 264 *G. Indica*. B: 4.5mm, Dana St. 3542 I, C: 7.8mm, Dana St. 3738 IV, D: 15.0 mm, Dana St. 3738 IV. All from Johnson & Bertelsen (1991)


A
B
C

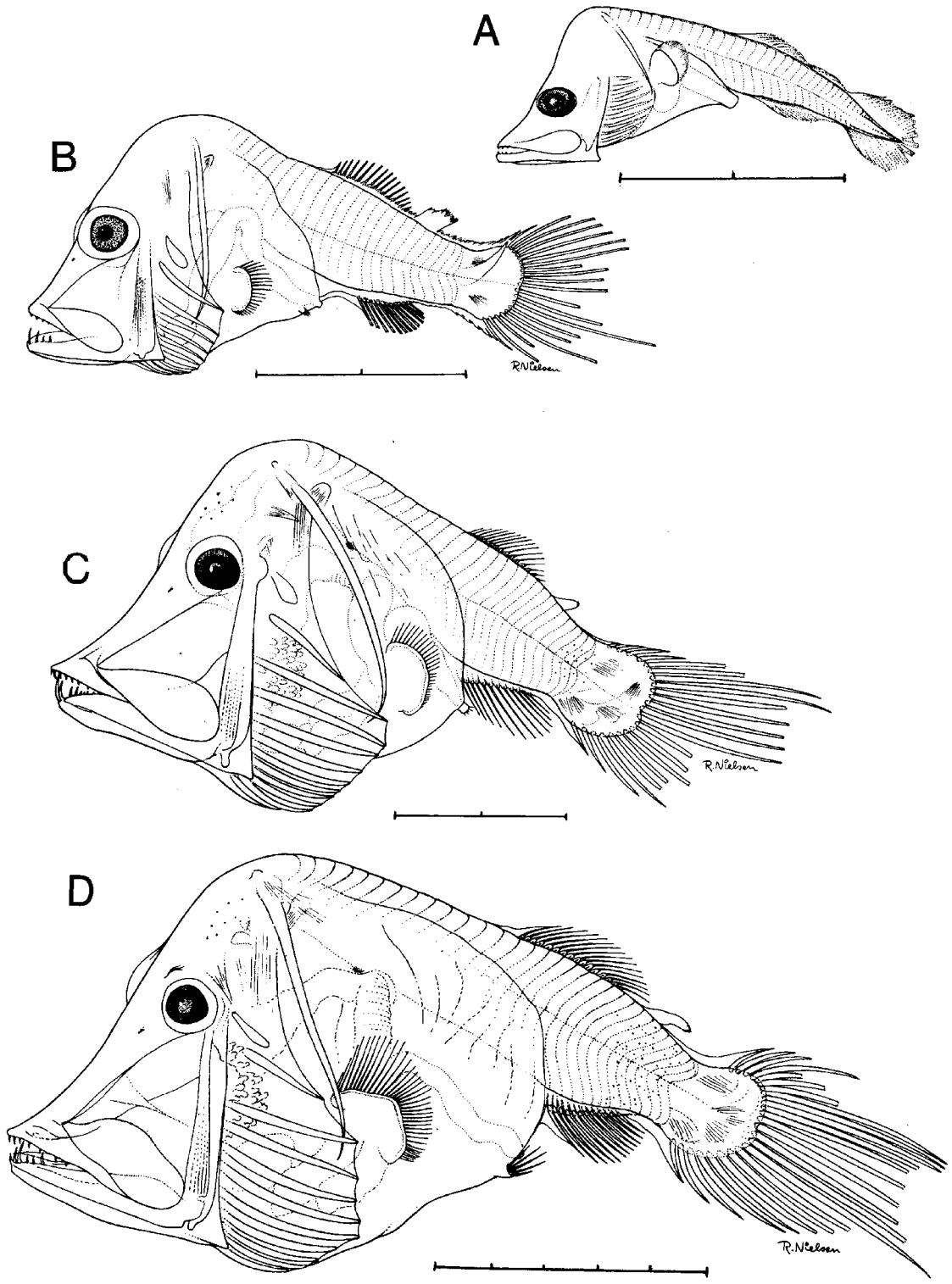


Fig. 2. Larvae of *Gigantura indica*. A: 3.6mm, HUP 264 *G. Indica*. B: 4.5mm, Dana St. 3542 I, C: 7.8mm, Dana St. 3738 IV, D: 15.0 mm, Dana St. 3738 IV. Adapted from R. K. Johnson & E. Bertelsen (1991).

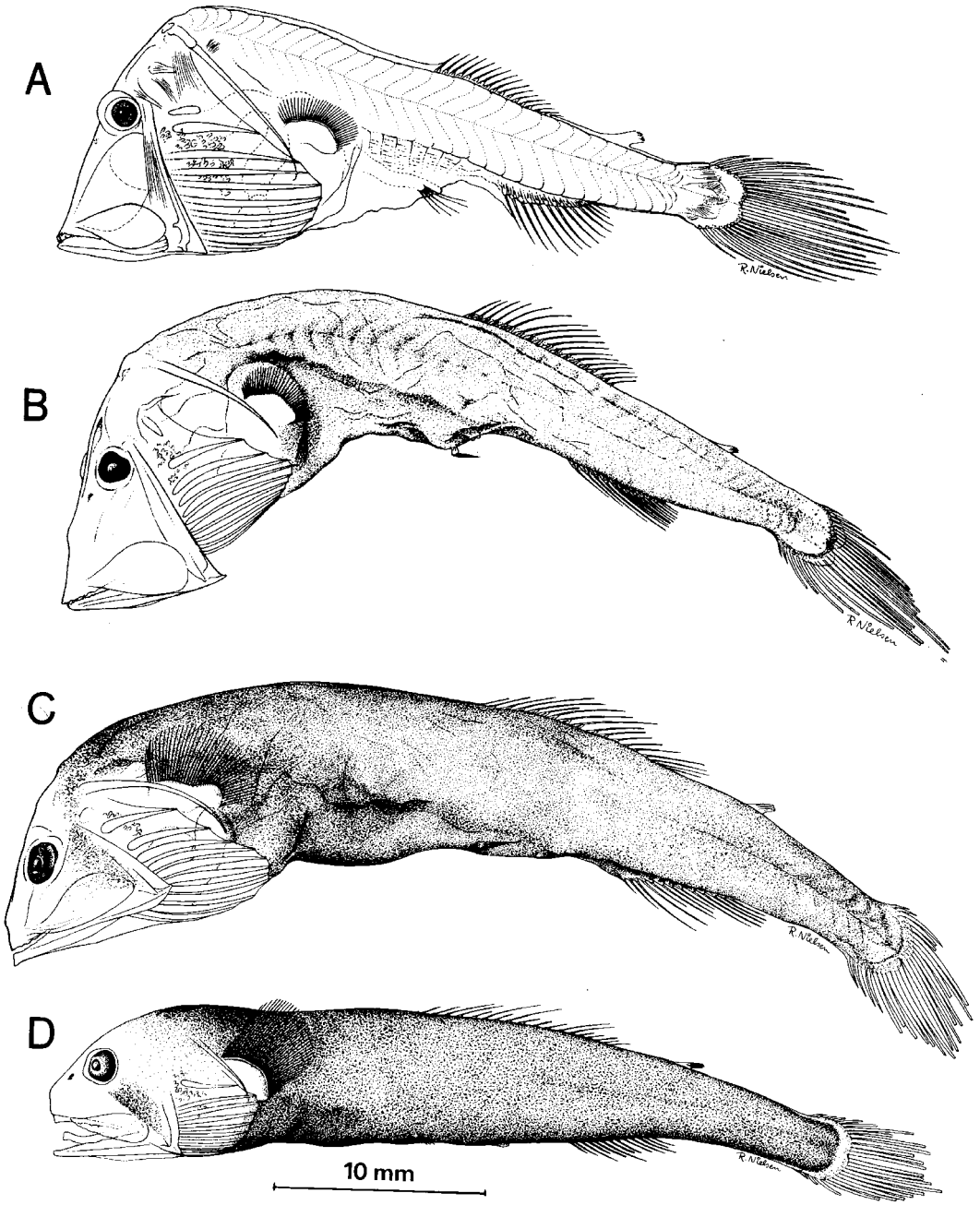


Fig 1. Transformation in *Gigantura indica*. A: Late larval stage, 28mm, ZMUC P2340605. B: Early stage of transformation, 36mm, SIO 68-482. C: Intermediate stage of transformation, 46mm, SIO 71-298. D: Late stage of transformation, 38mm SIO-68-478. (All same scale)

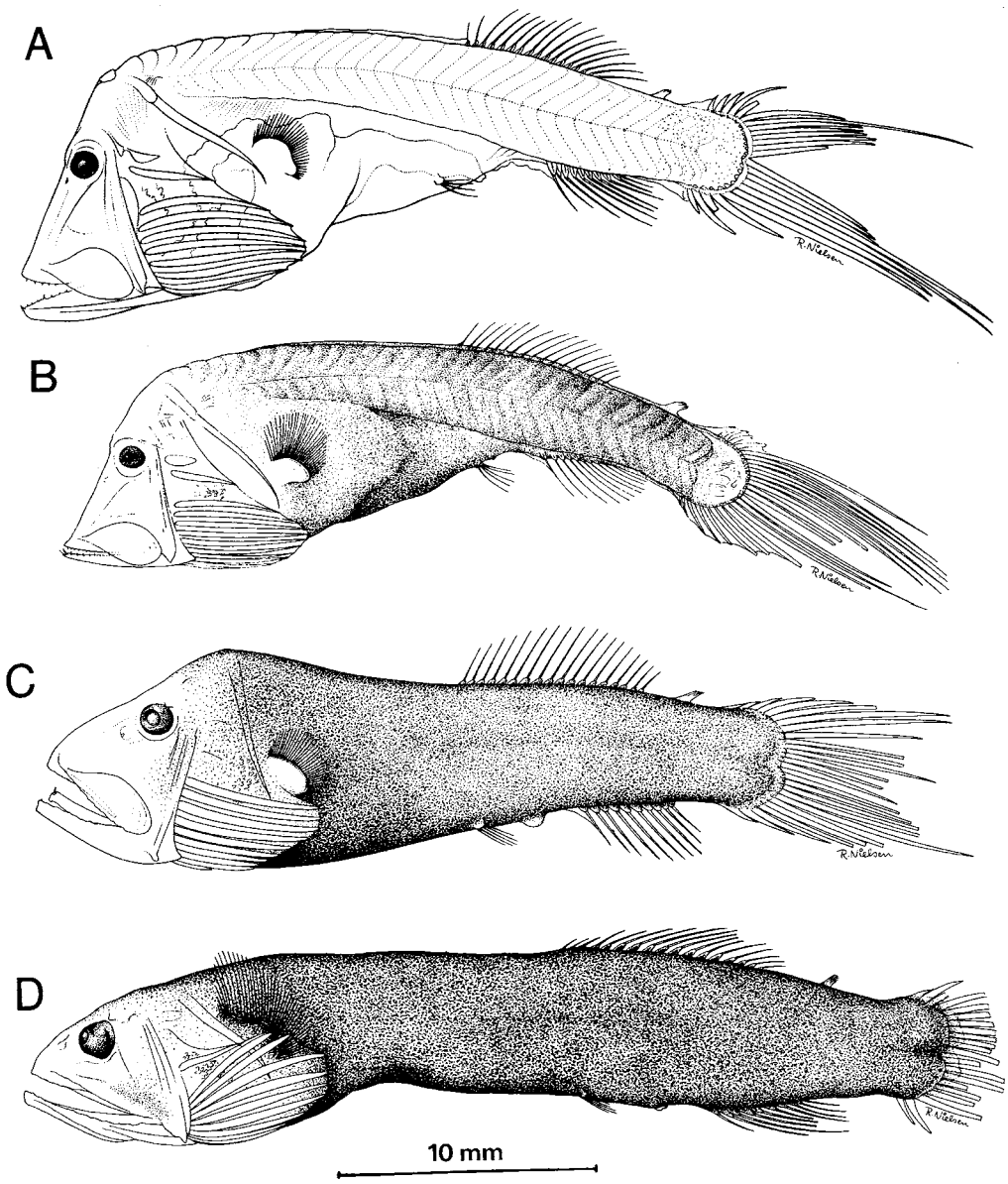


Fig. 2 Transformation in *Gigantura chuni*. A: Late larval stage, 30mm, MCZ 92390. B: Early stage of transformation, 28mm, MCZ 60570. C: Intermediate stage of transformation, 29mm, LACM 36040. D: Late stage of transformation, 37mm, IOS, Discovery St. Adapted from R. K. Johnson & E. Bertelsen (1991).

Table Giganturidae 1. Comparison of characteristics for the identification of larval *Gigantura chuni* and *G. indica*

Characteristic	*G. chuni*	*G. indica*
pectoral fin rays	30-33	36-42
anal fin rays	8-10	11-14
depth of caudal peduncle as % of SL	12-16% (14)	7.4-11% (9.5)
interorbital width as % of SL	5.9-13% (9.4)	12-20% (15)
caudal peduncle X-section	oval	round

Table Giganturidae 2. Comparison of larvae and adult characteristics of *Gigantura* sp.
Table adapted from Johnson and Bertelsen, (1991)

Characteristic	Larvae	Adults
15. body shape	short, deep and rotund	elongate, shallow and slender
16. snout shape	pointed	round
17. gape	does not extend posteriorly of the eye	extends very posterior to the eye
18. pigmentation	transparent, with few scattered larval melanophores	densely pigmented, black with bright silvery layer
19. eyes	round, laterally directed, mobile, placed high above jaws	tubular, directed rostrad, immobile placed close to upper jaws
20. teeth	non-depressible	posterior hinged
21. (?) teeth)	2-4	absent
22. maxillary	short, posteriorly not reaching below anterior part of the eye max in gape	long, posteriorly reaching far behind the eye, max excluded from gape
23. branchiostegal rays	10, large flattened	absent
24. pelvic fins	pedunculate with 5 rays	absent
25. adipose fin	present	absent
26. orien. of pectoral fins	vertical; behind gill slit	nearly horizontal; above gill slit
27. ?rent caudal finrays(3)-4-(5)		(0)-1(2-3)
28. cleithra	massive cleithra	absent

Table Giganturidae 3. Comparison of characteristics used in the separation of adult *Gigantura chuni* from *G. indica*

Characteristic	*G. chuni*	*G. indica*
Head length as % of SL	25%	15%
Depth of the body	200% seen in *G. indica*	-
Depth of caudal peduncle	300% seen in *G. indica**1	-
Olfactory papilla	elongate, clubshaped and proximally pigmented*2	shorter, broader, unpigmented

*1 this characteristic also separates the two larval species
*2 proximal pigmentation visible in older (larger) speciemens of *G. chuni*

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